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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/521,378	01/18/2005	Frank Haase		2319
7590 Jennifer D Adamson Shell Oil Company Intellectual Property PO Box 2463 Houston, TX 77252-2463				
			EXAMINER PRICE, CARL D	
			ART UNIT 3749	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/521,378

Applicant(s)

HAASE, FRANK

Examiner

CARL D. PRICE

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Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01/07/2008 (RCE).
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2 and 4-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2 and 4-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/06)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____
- Paper No(s)/Mail Date _____

DETAILED ACTION

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(c), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(c) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on **01/07/2008** has been entered.

Response to Arguments

Applicant's arguments with respect to claims **1, 2** and **4-28** have been considered but are moot in view of the new ground(s) of rejection.

Independent claims 1, 15 are 18 are remain in the form previously presented.

Claims 7, 11, and 28 have been amended.

New claims 29 and 30 have been added.

Claims 1, 2 and 4-30 are under examination.

Claim 1 (Previously Presented)

Process for combusting a liquid Fischer-Tropsch derived fuel comprising:(a) obtaining a droplet mixture comprising droplets of the liquid Fischer-Tropsch derived hydrocarbon fuel in an oxygen containing gaseous phase;(b) subjecting the droplet mixture to a cool flame under evaporation conditions effective to produce an evaporated gaseous mixture comprising oxygen and hydrocarbons, the cool flame having a temperature of between 300⁰ C and 480⁰ C when the pressure is 1 bar; and(c) combusting the evaporated gaseous mixture under combustion conditions effective to produce a heat of combustion. **15. (Previously Presented)**A process for combusting a liquid Fischer-Tropsch derived hydrocarbon fuel, the process comprising: (a) obtaining a droplet mixture comprising droplets of the liquid Fischer-Tropsch derived hydrocarbon fuel in an oxygen containing gaseous phase;

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- (b) subjecting the droplet mixture to a cool flame under evaporation conditions effective to produce an evaporated gaseous mixture comprising oxygen and hydrocarbons, the cool flame having a temperature of between 300 °C and 480 °C when the pressure is 1 bar, and
- (c) completely combusting the evaporated gaseous mixture under combustion conditions effective to produce a heat of combustion. 16. (Previously Presented) The process of claim 15 further comprising:
 - (d) performing one or more procedure selected from the group consisting of heating water by indirect heat exchange of the heat of combustion in one or more boiler and heating space directly with the heat of combustion.

18. (Previously Presented)

A process for combusting a liquid Fischer-Tropsch derived hydrocarbon fuel, the process comprising:

- (a) subjecting the liquid Fischer-Tropsch derived hydrocarbon fuel to a cool flame under evaporation conditions effective to produce an evaporated gaseous mixture comprising oxygen and hydrocarbons, the cool flame having a temperature of between 300 °C and 480 °C when the pressure is 1 bar; and,
- (b) combusting the evaporated gaseous mixture under combustion conditions effective to produce a heat of combustion.

Applicant argues that “None of the prior art references referred to here teach or suggest subjecting the droplet mixture to a cool flame under evaporation conditions effective to produce an evaporated gaseous mixture comprising oxygen and hydrocarbons, the cool flame having a temperature of between 300 °C and 480°C when the pressure is 1 bar.”

More specifically, applicant acknowledges that while **US004764266 (Chen et al)**, “... describes an integrated refining scheme for hydroprocessing high boiling fractions such as gas oil and catalytically cracked cycle oils to produce premium quality distillates.” Applicant further asserts that “The patent briefly mentions that Fischer-Tropsch synthesis products may be fed to the two stage hydrocracking process described in the patent.”

In response to applicant’s remarks directed to the teachings presented in **US 4764266 (Chen et al)** the examiner notes that this patent does however nonetheless provide a clearly stated and explicit teaching, albeit only briefly mentioned, to the person having ordinary skill in the art that at the time of applicant’s invention very low nitrogen containing liquid fuel products of the type suitable for home heating fuel were known to be “derived” from Fischer-Tropsch synthesis products.

Applicant further comments that **US004054407 (Carruba et al)** "... describes a method for combusting nitrogen-containing fuel also known as 'dirty fuel' such that the level of NO_x emissions is reduced. Dirty fuels 'have typically contained, as impurities, sizable amounts of fuel nitrogen, i.e., nitrogen-containing compounds,' and 'a fuel containing less than about 0.05% by weight of nitrogen present in such nitrogen-containing compounds would not be considered to be a nitrogen-containing fuel.' See col. 1, lines 41-48 and col. 4, lines 57-60."

Applicant further comments that the method described in **US004054407 (Carruba et al)** "comprises a two-stage combustion with an optional preheating step. The patent discloses that the preheating may be carried out by controlled preburning of the fuel-air feed which is controlled to raise the temperature of the feed to no more than 1000°C, and preferably no more than 700 °C. See col. 10, lines 17-51. This preburning occurs as a result of "burning a portion of the available fuel before the first stage." See col. 10, lines 27-28."

Applicant further acknowledges that **Suppes et al** (Compression-Ignition Fuel Properties of **Fischer-Tropsch Syncrude**, Ind. Eng. Chem. Res. 1998, 37 2029-2038) "teaches that syncrude, a Fischer-Tropsch synthesis product can be used as a compression-ignition fuel without further refining the syncrude. The article compares the syncrude to diesel fuel and describes possible additives that could be added to the syncrude so that it would meet diesel fuel specs in at least some parts of the world."

And, finally applicant notes that **US03810732 (Koch)** "describes a method of flameless combustion of a gaseous or vaporous fuel- air mixture accomplished without a catalyst. The apparatus is heated to 950 °C and then the flow rate is increased. "[IT]he large radiating surface formed by the highly porous structure cause[s] rapid heating of the reactants... [with] ensuing rapid evaporation of the fuel." See col. 3, lines 10- 13. The temperature is typically maintained between about 1500 °C and 2000 °C. See col. 3, lines 66-68. The patent teaches that if a liquid fuel is used, means of evaporating the fuel may be provided. See col. 5, lines 13-14. "The fuel can, for instance, be evaporated by heating the feed line or it could be sprayed, for instance, by means of a nozzle." See col. 5, lines 14-17."

Applicant's remarks conclude with the statement that "The Examiner has failed to overcome the burden of making a prima facie case of obviousness of the invention as claimed in claim 1." And, that "The '407 patent describes an optional preburning step, but it does not teach

or suggest subjecting the mixture to a cool flame as claimed in claim 1 of the present application.”

In response to applicant's arguments against the references of **US004054407 (Carruba et al)**, **Suppes et al** (Compression-Ignition Fuel Properties of Fischer-Tropsch Syncrude, Ind. Eng. Chem. Res. 1998, 37 2029-2038), **US004764266 (Chen et al)** and **US03810732 (Koch)** individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

The prior art references of **US 3620657 (Robinson)** and **DE19860308 (KOEHNE et al)** are now relied on to more fully support the examiner's position that “cool flame” vaporization or evaporation of liquid fuels was known at the time of the invention as a suitable means of both increasing combustion efficiency and for reducing environmental pollutants. And, to address applicant's assertion that “the Examiner has not met the burden of *prima facie* obviousness.” with regard to cool flame combustion.

With regard to applicant's invention and regarding that which a person having ordinary skill in the art would have known at the time of the invention applicant's attention is directed to the following observations and as well as noted teachings appearing in this field of endeavor.

US004054407 (Carruba et al) is relied on to show that it is known to minimizing nitrogen oxide emissions in combustors used in furnaces, boilers, gas turbines, etc. by operating the combustor such that a preliminary mixture of fuel and air is burned upstream of the catalyst to provide preheated gases for the fuel-air feed to the catalyst inlet, so that the feed mixture entering the catalyst has an elevated temperature within the desired range, in order to sufficiently high to vaporize relatively heavy fuel feeds. In **US004054407 (Carruba et al)** the preliminary mixture of fuel and air is burned upstream of the catalyst occurs as a controlled preburning which means that the temperature of the fuel-air feed at the “*inlet to the first stage catalyst*” of this process is raised to “*no more than*” preferably “*about 700 ° C (about 1,300 ° F)*”, or no more than 572 ° F - 896 ° F. The controlled preliminary cool flame (572 ° F - 896 ° F.) **US004054407**

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(Carruba et al) being sufficiently high to vaporize relatively heavy fuel feeds, meets the applicant's claim with regard to subjecting the droplet mixture to a cool flame under evaporation conditions effective to produce an evaporated gaseous mixture comprising oxygen and hydrocarbons, the cool flame having a temperature of between 300⁰ C and 480⁰ C (572 ° F - 896 ° F) when the pressure is 1 bar (i.e. - 1 atmosphere; or ambient pressure). Furthermore, with regard to this aspect of applicant's claimed invention, it is noted that the pressure of 1 bar merely indicates applicant intends the combustion process occur at atmospheric pressure.

With regard to liquid Fischer-Tropsch (F-T) fuels (also known as **Gas-to-Liquid fuels (GTL fuels)**) as it relates to "middle distillate fuels" **fuel oils**, such as **diesel fuel, kerosene and jet fuel** which are fuels conventionally used to operate combustion heating (**boiler, hot air furnaces**) and power driven (jet or turbine) apparatus, applicant's attention is directed to the following range of teachings found in the prior art:

20040128905 discloses the following:

[0002] **Known diesel fuel** components include the reaction products of Fischer-Tropsch methane condensation processes, for example the process known as **Shell Middle Distillate Synthesis** (van der Burgt et al, "The Shell Middle Distillate Synthesis Process", paper delivered at the 5th Synfuels Worldwide Symposium, Washington D.C., **November 1985**; see also the November 1989 publication of the same title from Shell International Petroleum Company Ltd, London, UK). **These Fischer-Tropsch derived gas oils are low in undesirable fuel components** such as **sulfur, nitrogen and aromatics** and are typically blended with other diesel base fuels, for instance petroleum derived gas oils, to modify the base fuel properties.

US004976882 (Martella et al) teaches that commonly known normally liquid fuel oils are diesel fuels, distillate fuels and heating oils are normally generally derived from petroleum sources, e.g., normally liquid petroleum distillate fuels, although they may include those produced synthetically by the Fischer-Tropsch (F-T) derived fuels.

US004976882 (Martella et al) discloses the following:

"... The **normally liquid fuel oils** are generally derived from **petroleum sources**, e.g., normally **liquid petroleum distillate fuels**, **though they may include those produced synthetically** by the **Fischer-Tropsch** and related processes, the processing of organic waste material or the processing of coal, lignite or shale rock. Such fuel compositions have varying boiling ranges, viscosities, cloud and pour points, etc., according to their end use as is well known to those of skill in the art. Among **such fuels are those commonly known as diesel fuels, distillate fuels, heating oils, residual fuels**, bunker fuels, etc., which are **collectively referred to herein as fuel oils**. The **properties of such fuels are well known** to skilled artisans as illustrated, for example, by **ASTM Specification D #396-73, available from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa. 19103.**"

Particularly preferred fuel oils include **middle distillates boiling** from about **120.degree. to 725.degree. F. (e.g., 375.degree. to 725.degree. F.)**, including **kerosene, diesel fuels, home**

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heating fuel oil, jet fuels, etc., and most preferably whose 20% and 90% distillation points differ by less than 212.degree. F., and/or whose 90% to final boiling point range is between about 20.degree. and 50.degree. F. and/or whose final boiling point is in the range of 600.degree. to 700.degree. F.

US006392108 (O'Rear) discloses the following:

- (4) The majority of combustible fuel used in the world today is derived from crude oil. There are several limitations to using crude oil as a fuel source. Crude oil is in limited supply; it includes aromatic compounds that may be harmful and irritating, and it contains sulfur and nitrogen-containing compounds that can adversely affect the environment, for example, by producing acid rain.
- (5) Combustible liquid fuels can also be prepared from natural gas. This preparation involves converting the natural gas, which is mostly methane, to synthesis gas, or syngas, which is a mixture of carbon monoxide and hydrogen. An advantage of using products prepared from syngas is that they do not contain nitrogen and sulfur and generally do not contain aromatic compounds. Accordingly, they have minimal health and environmental impact.
- (6) Fischer-Tropsch chemistry is typically used to convert the syngas to a product stream that includes combustible fuel, among other products. These Fischer Tropsch products have very low levels of sulfur, nitrogen, aromatics and cycloparaffins. The Fischer Tropsch derived fuels are considered "green fuels" and are desirable as environmentally friendly.
- (54) "Fischer-Tropsch derived products" mean any hydrocarbonaceous products derived from a Fischer Tropsch process. Fischer Tropsch derived products include, for example, Fischer Tropsch naphtha, Fischer Tropsch jet fuel, Fischer Tropsch diesel fuel, Fischer Tropsch solvent, Fischer Tropsch lube base stock, Fischer Tropsch lube base oil, Fischer Tropsch LPG, Fischer Tropsch synthetic crude, and mixtures thereof.

US 20020111521 (O'Rear) discloses the following:

[0022] The term "distillate fuel/distillate fuel fraction" means a hydrocarbon with boiling points between about 250.degree. F. and 1100.degree. F., preferably 300.degree. F. and 700.degree. F. The term "distillate" means that typical conventional fuels of this type can be generated from vapor overhead streams of petroleum crude distillation. In contrast, residual fuels cannot be generated from vapor overhead streams of petroleum crude distillation, and are a non-vaporizable remaining portion. Within the broad category of distillate fuels are specific fuels that include: naphtha, jet fuel, diesel fuel, kerosene, aviation gasoline, fuel oil, and blends thereof. Distillate fuel as used herein may mean distillate fuels prepared by Fischer Tropsch processes as well as distillate fuels generated from conventional petroleum crude distillation as appropriate in the context.

US005952539 (Selmandi et al) discloses:

"Typical feed stocks suitable as feedstocks to the steam cracking units of the present invention include light paraffins, such as ethane and liquid petroleum gases (LPG), gasolines, naphthas, and gas oils (i.e., middle distillates). As used in this application, "gas oil" refers to both the so-called light gas oils having an average boiling point from about 230.degree. C. to 340.degree. C., as well as the so-called heavy gas oils having an average boiling point from about 315.degree. C. to about 545.degree. C. Middle distillates are those fuels typically used as kerosene, home heating oils, diesel motor fuels.

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US 6652609 (Caprotti) discloses:

"Middle distillate fuel oils generally boil within the range of about 100.degree. C. to about 500.degree. C., e.g. 150.degree. to about 400.degree. C., for example, those having a relatively high Final Boiling Point of above 360.degree. C. (ASTM D-86). ... The most common middle distillate fuels are jet fuels, diesel fuels and heating oils. The heating oil may be a straight atmospheric distillate, or it may contain minor amounts, e.g. up to 35 mass %, of vacuum gas oil or cracked gas oils or of both.

US 6277894 (Agee et al) discloses the following:

As concerns over pollution caused by traditional fossil fuels increases and as sources of crude oil decrease, there has been increased interest in other sources of energy. One promising source of energy is the synthetic production of fuels, lubricants, and other products from natural gas (referred to at times as gas-to-liquids or GTL) preferably through the Fischer-Tropsch process. See for example U.S. Pat. Nos. 4,883,170 and 4,973,453, which are incorporated by reference herein for all purposes.

An exciting aspect of the products that may be made from or as part of the Fischer-Tropsch products are synthetic fuels and blends, including Fischer-Tropsch compression ignition fuels, Fischer-Tropsch spark ignition fuels, feedstocks for fuel cells, aviation fuel (turbine and spark-ignition) and railroad fuels. The sulfur-free clean nature of the synthetic fuels thus made are advantageous.

Kerosene is defined as:

"A thin oil distilled from petroleum or shale oil, used as a fuel for heating and cooking, in lamps, and as a denaturant for alcohol. Also called coal oil, lamp oil."
(The American Heritage® Dictionary of the English Language Hardback, 0-395-82517-2 Publication date: 2003)

In view of the forgoing information, middle distillate fuels of the type having properties suitable for operating combustible heating and power generation systems would have been understood, by a person having ordinary skill in the art at the time of the invention, to be fuels included in the group of gasoline, kerosene, GTL (gas -to-liquid), Fischer-Tropsch derived fuels, heating or residential liquid fuels. That is, at the time of the invention the person having ordinary skill in the art would have known and understood that liquid heating fuels are necessarily selected from available hydrocarbon middle distillate fuels which include both normally liquid petroleum distillate fuels and those produced synthetically by the Fischer-Tropsch and have boiling points between about 120 and 725 degrees F. Therefore, the examiner maintains the position that it would have been obvious to a person having ordinary skill in the art to fuel heating and power generating combustion apparatus, such as water heaters, air heaters, jet engines and piston motors, with a known middle distillate Fischer-Tropsch derived fuel having a

boiling points of between 160–400 degree C, in the manner set forth in applicant's claims. That is, at least for the purpose of taking advantage of the known clean nature (see US 6277894 (Agee et al)) of these Fischer-Tropsch derived synthetic fuels. More specifically, Fischer Tropsch products are considered "green fuels" and are desirable as environmentally friendly because they have very low levels of sulfur, nitrogen, aromatics and cycloparaffins, which if present during combustion are known to adversely affect the environment, for example, by producing acid rain (See US006392108 (O'Rear)).

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, means for "producing steam from the heat of combustion" and "means for superheated the steam", "a power piston or expansion engine" powered with the superheated steam (claim 5); "a porous surface to produce radiant heat (claim 6); a "space" heated with "radiant heat" (claim 7); means for performing the step of forming an "aerodynamically stabilizing the flame" (claim 8); "a flame detector" associated with "the combustion condition" (claim 11); means for "heating water by indirect heat exchange", a "boiler" "heating space directly" heated by the heat of combustion (claim 12) must be shown or the feature(s) canceled from the claim(s). Furthermore, it is noted that new claims 15-28 include at least the same informalities. Applicant should review all of the claims for further and similar structure which is claimed but not shown. **No new matter should be entered.**

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over **US004054407 (Carruba et al)** in view of **Suppes et al** (Compression-Ignition Fuel Properties of Fischer-Tropsch Syncrude, Ind. Eng. Chem. Res. 1998, 37 2029-2038), **US004764266 (Chen et al)** and **US03810732 (Koch)**, **US 3620657 (Robinson)** or **DE19860308 (KOEHNE et al)**.

US004054407 (Carruba et al) shows and discloses (see the additional discussion herein above) the invention substantially as set forth in the claims with possible exception to:

- the fuel being a liquid Fischer-Tropsch derived hydrocarbon fuel having the properties set forth in applicant's claims;
- a power piston or expansion engine powered with the superheated steam (claim 5);
- a space heated with radiant heat (claim 7);
- a flame detector associated with the combustion condition (claim 11);
- means for heating water by indirect heat exchange; and
- a boiler heating space directly heated.

US004054407 (Carruba et al) shows and discloses the following:

(3) In general, nitrogen oxides are formed as by-products of combustion processes carried out with air at relatively high temperatures ... The term stoichiometric amount of air means that amount of air which is theoretically sufficient for complete oxidation of all the combustible components in a given amount of fuel (e.g., to carbon dioxide and water). Particularly in combustors used in **furnaces, boilers**, process drying equipment, and **gas turbines**, in which peak combustion temperatures typically exceed about 3,200.degree. F, atmospheric nitrogen in the feed to the combustors is oxidized to produce relatively large amounts of nitrogen oxides. **As a result, the conventional high temperature combustors used for producing heat and power in modern technology have tended to cause the accumulation of nitrogen oxides in the atmosphere.** In fact, the discharge of nitrogen oxides from various sources has become an environmental hazard, especially in urban areas. For this reason, governmental agencies are concerned with more or less stringent nitrogen oxide emission standards for all combustion equipment.

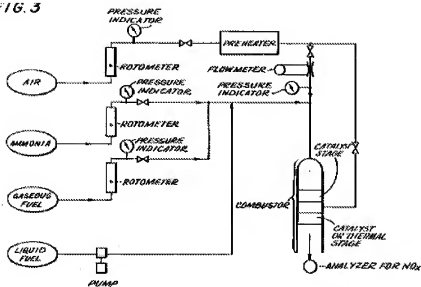
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(5) One proposal for minimizing such formation of nitrogen oxides involves operating a **fire tube boiler** with combustion of the fuel in two stages, the boiler being extended somewhat to provide two axially aligned combustion chambers. **(Paper by D. W. Turner and C. W. Siegmund, "Staged Combustion and Flue Gas Recycle: Potential for Minimizing NO_x from Fuel Oil Combustion", presented at The American Flame Research Committee Flame Days, Chicago, Ill., Sept. 6-7, 1972). To aid in limiting total formation of nitrogen oxides** from nitrogen-containing compounds in the fuel as well as from atmospheric nitrogen in the combustion air, it was proposed to operate the first stage moderately fuel-rich; some excess air is added to the partially combusted effluent, and the remaining uncombusted fuel is burned in the second stage. The modified boiler was tested ..."

- (10) When carrying out the two stage combustion of this application utilizing the preferred range of air-fuel ratios for the first stage, **combustion in the first stage** can be suitably carried out under essentially **adiabatic conditions** to produce an effluent of high thermal energy. In addition, when the amount of air in the first stage is 0.2 to 0.5 times stoichiometric, this combustion process can be suitably carried out without the necessity of **cooling any part** of the combustion system in order to **assure that the first stage combustion zone operates below temperatures** at which substantial oxidation of atmospheric nitrogen occurs. ... Also when utilizing the preferred range of air-fuel ratios, the first stage can be suitably operated at high space velocities, e.g., about 0.05 to 10 or more million cubic feet per hour of combusted gas (at standard temperature and pressure) per cubic foot of catalyst-containing combustion zone volume. **Thereby, means are provided for generating thermal energy at high rates in a two stage combustion apparatus of practical size, while minimizing the amounts of nitrogen oxides formed from both nitrogen-containing compounds in the fuel and the atmospheric nitrogen fed to the two stages of the process.**
- (20) The fuel-air feed to the **first combustion stage** or the additional air added to the first stage effluent, or both, in carrying out the process of this invention may be preheated in a conventional manner. However, if **preheating of the fuel-air feed** is carried out by **preburning** the feed, only controlled preburning should be utilized. **By controlled preburning is meant that the temperature of the fuel-air feed at the inlet to the first stage catalyst of this process is raised to no more than about 1,000 C (about 1,850 F), preferably no more than about 700.degree. C (about 1,300 F), by burning a portion of the available fuel before the first stage.** In other words, a preliminary mixture of fuel and air is burned upstream of the catalyst to provide preheated gases for the fuel-air feed to the catalyst inlet, so that the feed mixture entering the catalyst has an elevated temperature within the desired range. The controlled preburning of this invention can be carried out catalytically or thermally in a conventional manner. **Controlled preburning** is particularly **useful for providing temperatures** at the inlet of the first stage catalyst that are **sufficiently high to vaporize relatively heavy fuel feeds**, such as shale oil, **thus facilitating the provision of an intimate admixture of**

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fuel and air to provide a homogeneous mixture at the inlet to the catalyst used in the first stage combustion zone. Controlled preburning also is useful for providing temperatures at the inlet of the catalyst in the first stage which are greater than the ignition temperature of the fuel feed used. In this regard, controlled preburning is particularly important when this combustion process is carried out with a fuel having a relatively high ignition temperature, such as methane, and when no means, such as a compressor, is available to preheat combustion air above ambient temperature.

FIG. 3**TWO STAGE COMBUSTION FLOW CHART**

Suppes et al (Compression-Ignition Fuel Properties of Fischer-Tropsch Syncrude, Ind. Eng. Chem. Res. 1998, 37 2029-2038) discloses burning light Fischer-Tropsch fuels or Syncrude (see page 2030, column 1, lines 27-36) in combustion apparatus such as internal combustion engines, as a suitable alternative to diesel and gasoline fuels (see page 2031, column 2, lines 4-35) in for example conventional diesel engines. Known light Fischer-Tropsch fuels disclosed by **Suppes et al** include the following properties:

- > 70% Fischer-Tropsch syncrude(see page 2031, column 2, lines 4-35), or 90% (by mass) of the light syncrude composition (see page 2029, column 2, lines 1-4);
- near-zero aromatic contents; and

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- a boiling point of 170.6-314.9° C (Table 1).
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US004764266 (Chen et al) discloses a process for using or burning middle distillate Fischer-Tropsch derived fuel having typically boiling in the 165.degree. to 345.degree. C. (about 330.degree. to 650.degree. F.) with lesser proportions of naphtha as a “home heating oil” (see column 10, line 16-34). This middle distillate fraction is, however, relatively low in sulfur and generally meets product specifications for use as a light fuel oil, e.g. home heating oil, diesel and jet fuels. In this regard Official Notice is taken that it is well known to burn “heating oil” in combustion apparatus associated with superheated steam boiler apparatus, and to use steam produced therefrom to power piston or expansion engines. **US004764266 (Chen et al)** acknowledges the presence of non-mineral fractions, or additives, in the Fischer-Tropsch distillate (e.g. – unconverted fractions).

US03810732 (Koch) teaches, form applicant’s same combustion and heating fuel field of endeavor, catalytic combustion (17,18; 21,22) of liquid fuel by first obtaining a mixture of liquid hydrocarbon in an oxygen containing gaseous phase (see column 9, lines 10-12) by evaporating the liquid hydrocarbon droplets to obtaining a gaseous mixture.

US 3620657 (Robinson) teaches, form applicant’s same combustion and heating fuel field of endeavor, combustion of liquid fuel by first obtaining a mixture of liquid hydrocarbon in an oxygen containing gaseous phase by evaporating the liquid hydrocarbon droplets to obtaining a gaseous mixture

US 3620657 (Robinson) discloses and shows:

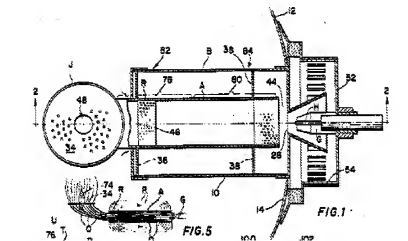
- (2) Oil-burning hot -water heaters of the type used in many households are unable to operate efficiently due in part to the design of the burners thereof and partly because the oil and air which provides the combustible mixture are both fed to such burners under considerable pressure. The combustion chambers of most domestic burners are considerably smaller than those of commercial hot water heaters for example.

- 15) When the burner is up to vaporizing heat, the maximum temperatures tested on the upper plate 34 have been 1,100 - 1,200 F. However the normal operating temperatures, reached in 2 to 3 minutes at this place are 700- 800 F. Between

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approximately the limits of bracket 78 (FIG. 1) maximum recorded temperatures have been 1,200-1,400 F. and between approximately the limits of bracket 80 they have been 1,200-1,400 F. However, the normal operating temperature approximately between the limits of brackets 78 and 80 are 850 - 1,000 F and 1,000 1,100 F. respectively and reached in 2 to 3 minutes as aforesaid. In the regions of the arrows 82 and 84, on the surface of jacket B maximum recorded temperatures have been 1,100 1,200 F. and 900-1,000 F. respectively, and after 2 to 3 minutes, **normal temperatures** at these two regions are approximately 900-1,000 F. and 700-800F, respectively.

(**Note:** The liquid fuel evaporation stage operating temperatures of US 3620657 (Robinson) are 700- 800 F which is within applicant's claimed 300 - 480 degrees C (572 - 896 degrees F))



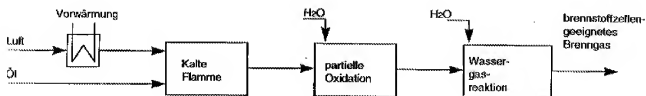
DE19860308 (KOEHNE et al)

ABSTRACT:

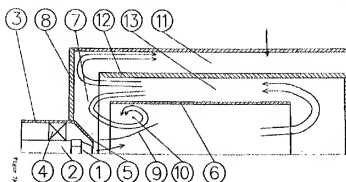
Process for evaluating a fuel comprises contacting the fuel with an oxidizer in a reaction chamber and adjusting the residence time in the chamber with limited removal of heat. Process for evaluating a fuel comprises: (A) contacting the fuel with an oxidizer heated to 520-880 K or at low pressure with a reduction of temperature and a molar ratio C/O of 1: 0.14-0.25 in a reaction chamber, in which exothermic prereactions are initiated in a cold flame that effects only a partial conversion of the fuel and the oxidizer on homogenous mixing of the fuel and oxidizer; and (b) adjusting the residence time t_v of the mixture produced in step (a) in the reaction chamber t_v 25 ms at **p not more than 1** with limited removal of heat from the reaction zone via an inert gas flow and/or the reaction chamber wall resulting in kinetic inhibition of the further reaction of the oxidizable mixture obtained by the cold flame.

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(**Note:** The liquid fuel evaporation operating temperature of **DE19860308 (KOEHNE et al)** is **520 - 880 K (246 - 546 C or 476 - 1016 F)** which is within applicant's claimed 300 - 480 degrees C (572 - 896 degrees F))



Schnittdarstellung eines Brenners



In regard to claims **1, 2** and **4-28**, for the purpose for providing a suitable clean and environmentally friendly alternative fuel for the **US004054407 (Carruba et al)** heating systems, it would have been obvious to a person having ordinary skill in the art to operate heating system burners with Fischer-Tropsch fuel having additives and low aromatic and sulfur content and a density similar to that of home heating fuels (i.e. - between 0.65 and 0.8 g/cm³ at 15° C), in view of the teaching of the **Suppes et al** or **US004764266 (Chen et al)**. For the purpose of providing a suitable burner for combusting the room temperature liquid fuel, it would have been obvious to a person having ordinary skill in the art to evaporate liquid hydrocarbon droplets to obtaining a gaseous mixture and thereafter combust the mixture in a porous catalyst, which inherently produces an aerodynamically stabilized radiant flame, in view of the teaching of **US03810732 (Koch)**, **US 3620657 (Robinson)** or **DE19860308 (KOEHNE et al)**. In regard to claims **11** and **28**, Official Notice is taken that ionization type sensors are well known means for detecting

flames. Therefore, in view of that which is well known and for the known purpose, it would have been obvious to a person having ordinary skill in the art to detect the flame of a heating system burner. Also, in regard to claims 29 and 30, US004054407 (Carruba et al) does not rely on a "metal based combustion improver", at least as best understood from the claims. In regard to claims 5, 6, 7, 12, 16, 17 and 21, Official Notice is taken that each of the claimed combustion heated systems (i.e. - power piston or expansion engine powered with the superheated steam (claim 5); a space heated with radiant heat, etc. are known applications for hydrocarbon fueled burners. Therefore, for the purpose applying the combustion process and system to a suitable use, it would have been obvious to a person having ordinary skill in the art to operate and arrange US004054407 (Carruba et al) in the manner set forth in applicant's claims.

Conclusion

See the attached USPTO Form 948 for prior art made of record and not relied upon which is considered pertinent to applicant's disclosure.

US 6102687 (Butcher) shows and discloses:

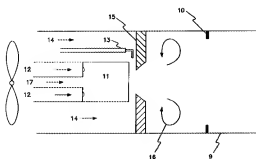


FIG. 2

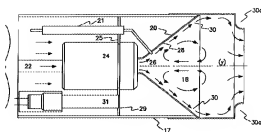


FIG. 3

(2) The invention relates to burning fuel more specifically, to a fuel burning combustion head using a low-pressure, high flow atomizing nozzle so that there will be a complete combustion resulting in a minimum emission of pollutants.

(3) For many years researchers have attempted to develop fuel burners which reduce emissions caused by unburned fuel. It has been discovered that a complete combustion of the fuel reduces emissions of pollutants particularly carbon monoxide, hydrocarbons, and soot. In burning liquid fuels, the problem is to provide sufficient oxygen for complete combustion of the carbon and hydrogen in the fuel to carbon dioxide and water, without high levels of excess air, which leads to reduced operating efficiency. This has led to an understanding that along with complete mixing, flame temperature and residence time affect the emissions levels released into the atmosphere. As a result **burners have been developed with a longer residence time and a lower flame temperatures (blue flame)**. The prior art includes devices using fuel pressure atomizing

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recirculating burners (using no combustion air for atomization), high pressure air atomizing burners which use only a very small fraction of combustion air for atomization, and low pressure air atomizing burners which use a small percentage of the combustion air for atomization.

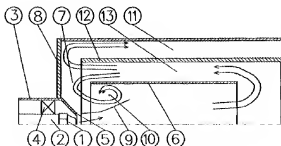
(3) As shown in **FIG. 1** the **oil fuel burner (1)** comprises a burner flame tube low pressure air atomizer nozzle (2). Primary air enters the flame zone through the atomizer (2). The low pressure air entering at (3) and low pressure fuel (8) accelerate and swirl as they exit the atomizer (2) as a swirling air jet with a fine spray entrained. The retention plate (5), baffle plate (7) and flame tube (1) confine the expanding jet forcing a toroidal recirculation pattern. **This recirculation zone (6) provides heat feedback necessary to stabilize the flame** supplied by the ignition source (4). **A strong flow in the recirculation zone (6) reduces the NOx emissions.** The invention comprises a new and unique combination fuel burner which uses a low pressure air atomizer (2) to create the desired **blue flame** effect. **In addition,** it provides for a unique configuration which creates a swirling effect of the combustion gases. **This swirling effect strongly influences the toroidal recirculation zone (6) leading to the recirculation into the flame of combustion products.** The combustion products can be relatively cool and low in oxygen. The baffle plate (7) defines the boundary of the toroidal recirculation zone. **The baffle plate (7) controls the fraction of gas in the recirculation zone** which comes from outside of the flame tube. **This improves the flames stability and lowers NOx emissions.** The size of the baffle plate (7) controls flames intensity. **A larger baffle generates a hotter, yellow flame and a more stable flame, while a smaller baffle plate creates a cooler blue flame. The bluer, cooler flame is desired because it results in lower NOx emission.** By controlling the size of the baffle plate, the length of the flame tube the burner can operate in either a **blue or yellow flame mode.**

DE 19834051 A1 (KOEHNE et al)

ABSTRACT:

An improved design of burner for **liquid fuels** has the fuel and air mixture directed into a **vaporizing chamber (6)** coaxial inside the burn chamber (11) and with a return flow (13) between the two chambers. Part of the return flow, which has a **cold flame** effect, is ducted back into the **vaporizing chamber** to enhance the phase change of the fuel. The remainder of the **cold flame** effect mixture of **fuel vapour**, oxygen and other gasses passes into the burn chamber at a **reduced start temperature** for an improved burn without depositing cracking compounds anywhere in the system.

Fig. 3: Schnittdarstellung eines Brenners



GB 2215032 A (Shin) shows and discloses:

While acknowledging certain drawbacks of using high ignition point liquid fuels (i.e. - kerosene and Diesel fuel) in portable space heaters **GB 2215032 A (Shin)** nonetheless recognizes kerosene and Diesel fuels as interchangeable and suitable equivalent fuels for use in space heaters. **GB 2215032 A (Shin)** teaches that increased efficiency and lowered environmental pollutants result when applying suitable preheating and gasifying techniques to the combustion of kerosene and Diesel fuels.

TITLE: PREHEATING-EXEMPT FUEL GASIFYING STOVE

This invention relates to a preheating-exempt fuel gasifying stove, or burner.

It is found that most fuels for gasifying stoves are kerosene and Diesel fuel oil which are of high igniting point. Hence, in order to cause the fuel to be burned easily, it is commonly suggested to set a preheating procedure so that the fuel will be heated prior to its gasification thereby helping the combustion of the fuel. However, the temperature increased in such preheating procedure is often insufficient to cause a complete combustion, thus wasting fuel, lowering the efficiency as well as polluting the atmosphere. Furthermore, the gasifying stove is usually connected externally with a tank of gas for igniting the gasifying fuel. Whereas, the gas tank will occupy a lot of space, causing much inconvenience in installation.

It is, therefore, an object of the present invention to provide a preheating-exempt fuel gasifying stove which may obviate and mitigate the above-mentioned drawbacks.

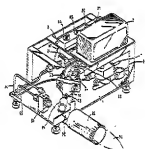


FIG. 2

The present invention is applicable to ~~kerosene~~^{kerosene}, Diesel fuel oil and heavy fuel oil. The combustion temperature may reach 1370 C in an open stove test and 1700 C in a closed stove test while the carbon monoxide concentration is merely 84--100ppm. It is estimated that the evolved heat for kerosene is around 10390 Kcal/kg which is much better than the commonly used stove.

S 4865543 (GARBO) discloses:

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Liquid fuel is fed by pump 19 through pipe 20 into heater 21 wherein the liquid fuel may be heated or even completely vaporized. The heated or vaporized fuel flows from heater 21 through pipe 22 into pipe 18 wherein it mixes with the preheated combustion air to form a hot, completely gaseous mixture which is supplied to porous fiber burner 11.

Upon igniting the preheated mixture of vaporized fuel and combustion air issuing at the exterior surface of porous fiber burner 11, flameless surface combustion takes place with the result that the entire exterior surface of burner 11 is substantially a uniform source of radiant heat. Water or other desired fluid flowing through coil 23 in furnace 10 absorbs radiant heat from burner 11 as well as heat from the hot combustion products or flue gas rising through furnace 10. The cooled but still hot flue gas discharges from furnace 10 through pipe 24 into heat exchanger 14 wherein it flows countercurrent to the combustion air supplied by blower 12 and pipe 13 and thus transfers more of its heat to the air stream. The further cooled flue gas leaves exchanger 14 through pipe 25.

While the examples involve petroleum fractions as the liquid fuel fed to the porous fiber burner in vapor form, similar hydrocarbon fractions can be obtained from tar sands, shale oil, coal liquefaction and synthetic fuels. In the future, such other liquid fuels may be economically attractive. The same may also be possible with liquid fuels such as alcohols derived from agricultural products. Hence, the liquid fuel selected for combustion in accordance with this invention may vary greatly so long as it is completely vaporizable. Obviously, the liquid fuel must be free of any ash residue. The selected liquid fuel should also have a low sulfur content to comply with the sulfur emission limitations of applicable ordinances.

US 6305331 (Fullermann et al) discloses a burner for a boiler:

The gas burner, designed in accordance to the intent of this invention, functions practically independently of the form or shape of the combustion chamber. It is especially suited for compact furnace designs with relatively short combustion chambers. The burner is not only suitable for burning gas. By replacing item 119 by a fuel injector that is appropriate for liquid fuels with the capability of generating a conical shroud spray pattern, the burner is then suitable for the combustion of heating oil extra light, "Eco-oil" or kerosene. With liquid fuels, the burner achieves exhaust emission values for Nox of less than 60 mg/KW.

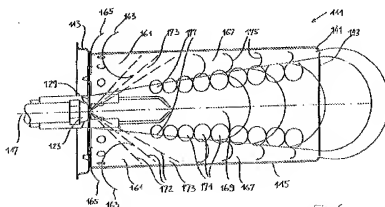


Fig. 6

US 4846665 (Abbasi)

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The above examples show **reduction in the flue gas NO_{sub}.x** of up to over 80 percent achieved by the process of this invention. Higher NO_{sub}.x the fuel-rich and fuel-lean oscillations provided reduction was observed at lower excess air levels with lower oscillating frequencies and with moderate heat removal from the combustor. These conditions are consistent with operation of most industrial burners and combustors. Higher CO emissions were generally observed with low NO_{sub}.x emissions and can be burned out with enhanced mixing. **The process of this invention has a wide range of applications for both gas and oil firing of commercial and industrial boilers and water heaters** to heavy industrial processes such as glass melting. The process of this invention is particularly useful for regenerative combustors, such as regenerative glass melters, since combustion air flow may be maintained constant.

As shown in FIG. 1, fuel introductory means 17 is fed fuel in a cyclic fashion from flow adjustment means 20. Any **gaseous or vaporous fuel** may be used in the combustion of this invention including **fossil derived** and **synthetic fuels**. Gaseous, liquid, vaporized liquid, pulverized solid, and solid/liquid mixed fuels may be used.

US 3846979 (Pfefferle)

The carbonaceous fuels utilized in the invention may be gaseous, liquid, or solid at normal temperature and pressure. **Suitable hydrocarbon fuels may include**, for example, low molecular weight aliphatic hydrocarbons such as methane, ethane, propane, butane, pentane, gasoline; aromatic hydrocarbons such as benzene, toluene, ethylbenzene, xylene; naphtha; **diesel** fuel; **jet** fuel; **other middle distillate fuels**; hydrotreated heavier fuels; and the like. Among the other useful carbonaceous fuels are alcohols such as methanol, ethanol, isopropanol; ethers such as diethylether and aromatic ethers such as ethylphenyl ether; carbon monoxide; and low ash chars.

Detailed Description Text - DETX (23):

In addition to employing the method of the present invention for **powering gas turbines**, the combustion system can be employed, for example, **as a heat source** in **steam boilers** wherein the heat of the exhaust gases are employed to generate steam as in a **water-tube boiler**, **air heaters**, **hot water heaters** and process furnaces.

USPTO CUSTOMER CONTACT INFORMATION

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CARL D. PRICE whose telephone number is (571) 272-4880. The examiner can normally be reached on Monday through Friday between 6:30am-3:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven B. McAllister can be reached on (571) 272-6785. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CARL D. PRICE/

Primary Examiner, Art Unit 3749